LOWER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: **Lower Medicine Lodge River**
Water Quality Impairment: Sulfate

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Medicine Lodge **Counties:** Barber & Harper

HUC 8: 11060003 **HUC 11** (HUC 14s)**: 040** (050, 060, 070, and 080)

Drainage Area: 903 square miles near Kiowa

Main Stem Segment: WQLS: 2; starting at the Oklahoma border and traveling upstream toward the confluence with Elm Creek. **(Figure 1)**

Tributary Segments: Non-WQLS: Antelope Creek *(22) unimpaired*
Wilson Slough *(23) unimpaired*

Designated Uses: Special Aquatic Life Support; Primary & Secondary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segment

1998 303d Listing: Table 3 - Predominantly Natural Conditions Impact

Impaired Use: Domestic Water Supply

Water Quality Standard: Domestic Water Supply: 250 mg/l at any point of domestic water supply diversion (K.A.R.28-16-28e(c) (3) (A); Livestock Watering: 1000 mg/l (Table 1a of K.A.R. 28-16-28e(d));

In stream segments where background concentrations of naturally occurring substances, including chlorides and sulfates, exceed the water quality criteria listed in Table 1a of KAR 28-16-28e(d), at ambient flow, the existing water quality shall be maintained, and the newly established numeric criteria shall be the background concentration, as defined in KAR 28-16-28b(e). Background concentrations shall be established using the methods outlined in the "Kansas implementation procedures: surface water," dated June 1, 1999. (KAR 28-16-28e(b)(9)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303(d): Not Supporting Domestic Water

Monitoring Site: Station 220 near Kiowa

Period of Record Used: 1986 to 2000

Flow Record: Medicine Lodge River near Kiowa (USGS Station 07149000; 1970-2000).

Long Term Flow Conditions: Median Flow = 102 cfs; 7Q10 = 1 cfs

Current Conditions: Sulfate concentrations have ranged from 164.0 mg/l to 892.0 mg/l over the period of record. Overall, the average sulfate concentration was 366 mg/l. Concentrations at flows less than median flow averaged 270 mg/l, while those at higher flows averaged 451 mg/l. There is a strong natural background concentration of sulfate in the Medicine Lodge River. Excursions were seen in all three seasons. Seventy-two percent of samples from water quality site 220 were over the criterion of 250 mg/l. More recent data have indicated higher consistency in exceeding the standard, possibly reflecting higher average flow conditions since 1996. Upstream monitoring at Medicine Lodge indicates the same pattern of exceedence with 75% of the samples taken in 1990, 1994 and 1998 greater than 250 mg/l. While high sulfate concentrations are seen coincidently at Medicine Lodge and Kiowa, there is little sulfate coming out of the headwater area above Belvidere, except at high flows.

Desired Endpoints of Water Quality (Implied Load Capacity) at Site 220 over 2005 - 2010: The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standards fully supporting Drinking Water Use. This TMDL will, however, be phased. The current standard of 250 mg/L of sulfate was used to establish the TMDL. However, the Medicine Lodge River is subject to loading of sulfate from underlying Permian geologic formation and their high gypsum content in the watershed. As such, the segment has elevated sulfate levels from this natural source, with a tendency to increase loading with flow. This natural background of sulfate at high flows, consistently above 250 mg/L, makes achievement of the Standard impossible at high flows. The average sulfate concentration at flows less than median are not significantly different from the Phase One endpoint, therefore, the 250 mg/l endpoint will apply to low flows. An alternative endpoint for high flows is needed, however.

Kansas Implementation Procedures for Surface Water allow for a numerical criterion based on natural background to be established. The specific stream criteria to supplant the general standard will be developed concurrent with Phase One of this TMDL following the appropriate administrative and technical Water Quality Standards processes. Meanwhile, a tentative endpoint has been developed based on currently available information and is 450 mg/L from data collected over 1986-2000 at flows greater than median flow. The Phase Two TMDL will be based on the future standard applied to high flows.

Seasonal variation has been incorporated in this TMDL through the documentation of the seasonal consistency of elevated sulfate levels. Achievement of the endpoints indicate loads are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored.

3. SOURCE INVENTORY AND ASSESSMENT

Background: The primary cause of the sulfate impairment of the Medicine Lodge River in Barber County is natural dissolution of gypsum (hydrated calcium sulfate) in the bedrock outcropping and underlying alluvial aquifer sediments in the watershed. The bedrock outcropping and underlying alluvial aquifer sediments consist of primarily shales, siltstones, and sandstones of the Permian System. These include strata in the Upper Permian and upper part of the Lower Permian Series, including the Dog Creek Shale, Blaine Formation, Flowerpot Shale, Cedar Hills Sandstone, and Salt Plain Formation, all of which contain gypsum beds, veins, or cement. The Blaine Formation contains gypsum beds of great enough thickness that they are mined in Barber County. The prevalence of gypsum at or near the land surface in Barber County contributes substantial amounts of sulfate to runoff and groundwater discharge to streams as a result of natural dissolution of the mineral. The sulfate concentration ranged from 190 to 676 mg/L in water of the Medicine Lodge River near Kiowa during 1995-1998 while the range in chloride content was 44-141 mg/L. The high sulfate/chloride ratio and the prevalence of gypsum in the bedrock fit the natural dissolution as the predominant source of mineralized water in the river. Any anthropogenic sulfate sources or hydrologic modifications increasing the sulfate concentration is insignificant in comparison with the natural sulfate source in the watershed.

Irrigation Return Flows: No impairment is associated with irrigation return flows off lands with flood irrigation. There is little irrigation in the watershed due to the prevalence of bedrock at or near the surface and the thin saturated thickness of unconsolidated sediments that are present. Most of the irrigation within the overall Medicine Lodge subbasin is located at the Pratt-Barber County line, associated with the southern extent of the Big Bend Prairie Aquifer in the headwaters of Elm Creek. Any return flows from those diversions would be low in sulfate because of the low sulfate content of the Big Bend Prairie Aquifer and as confirmed by samples taken on Elm Creek (sulfate average of 40 mg/l) Remaining irrigation is along the main stem of the river and some surface rights on headwater tributaries above Belvidere, but generally, those rights have not recently pumped water.

Contributing Runoff: The watershed's average soil permeability is 2.5 inches/hour according to NRCS STATSGO data base. About half of the upper watershed produces runoff under relative low (1.5''/hr) rainfall conditions, while it appears most of the lower watershed contributes runoff. Under very low (<1"/hr) potential conditions, the potential contributing area is concentrated to the lands southwest of Medicine Lodge and along the stream channel. Generally, storms producing less than 0.5"/hr of rain will generate runoff from along the stream channels.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

The source assessment has ascertained that natural sulfate loading within the watershed generally is responsible for the excursions seen at Kiowa.

Point Sources: A Wasteload Allocation of zero will be established by this TMDL because of the lack of point sources along the segment. Should future point sources be proposed in the watershed and discharge into the impaired segments, the current wasteload allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers.

Non-Point Sources: The elevated sulfate concentrations appear to stem from drainage of Permian geologic formations during high flows. The Load Allocation based on the existing standard will be 0.6-62 tons per day at flows of 1-102 cfs (below median flow). Using a background concentration for high flows exceeded less than 50% of the time would lead to loads of 112-1215 tons per day at flows of 102-1000 cfs.

Defined Margin of Safety: The Margin of Safety provides some hedge against the uncertainty of loading and the sulfate endpoint and will be ten percent of the applicable sulfate load, or 0.1-6.9 tons per day at 1-102 cfs and 12-121 tons per day at 102-1000 cfs with an elevated background concentration as the applicable criterion.

State Water Plan Implementation Priority: Because it appears this watershed's sulfate load is predominately natural, this TMDL will be a Low Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Medicine Lodge subbasin (HUC 8: 11060003) with a priority ranking of 49 (Low Priority for restoration).

Priority HUC 11s: Because of the natural geologic contribution of this impairment, no priority subwatersheds or stream segments will be identified..

5. IMPLEMENTATION

Desired Implementation Activities

1. Monitor any anthropogenic contributions of sulfate loading to river.
2. Establish alternative background criterion
3. Assess likelihood of river being used for domestic uses.

Implementation Programs Guidance

Non-Point Source Pollution Technical Assistance - KDHE

a. Evaluate any potential anthropogenic activities which might contribute sulfate to the river as part of an overall Watershed Restoration and Protection Strategy.

Water Quality Standards and Assessment - KDHE

a. Establish background levels of sulfate for the river and recommend an alternative water quality criterion for high flows.

Use Attainability Analysis - KDHE

a. Consult with Division of Water Resources on locating existing or future domestic points of diversion on the Medicine Lodge River for drinking water purposes.

Time Frame for Implementation: Development of a background level-based water quality standard should be accomplished with the 2002 water quality standards revision.

Targeted Participants: Primary participants for implementation will be KDHE .

Milestone for 2006: The year 2006 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, additional monitoring data from Medicine Lodge River will be reexamined to confirm the impaired status of the river and the suggested background concentration. Should the case of impairment remain, source assessment, allocation and implementation activities will ensue.

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Health and Environment.

Reasonable Assurances

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

3. K.S.A. 82a-901, et seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

4. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.

5. The *Kansas Water Plan* and the Lower Arkansas Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollutant reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are a Low Priority consideration and should not receive funding .

Effectiveness: Minimal control can be exerted on natural contributions to loading.

6. MONITORING

KDHE will continue to collect bimonthly samples at Station 220, including sulfate samples over each of the three defined seasons. Based on that sampling, the status of 303(d) listing will be evaluated in 2006 including application of numeric criterion based on background concentrations at high flows. Should impaired status remain, the desired endpoints under this TMDL will be refined and direct more intensive sampling will need to be conducted under specified seasonal flow conditions over the period 2006-2010.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Lower Arkansas River Basin were held March 9, 2000 and April 26-27, in Hutchinson, Wichita, Arkansas City and Medicine Lodge. An active Internet Web site was established at http://www.kdhe.state.ks.us/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Lower Arkansas River Basin. A draft of this TMDL has been maintained on the website since June 1, 2000 and modifications to the original draft have been available to the public for viewing and review up to the date of submitting this TMDL to EPA.

Public Hearing: A Public Hearing on the original draft of these TMDLs of the Lower Arkansas River Basin was held in Wichita on June 1, 2000.

Basin Advisory Committee: The Lower Arkansas River Basin Advisory Committee met to discuss the TMDLs in the basin on September 27, and November 8, 1999; January 13 and March 9, 2000. The Committee recommended approval of the Basin Plan which set high priority TMDLs in the basin, thereby, delegating medium and low priority status to this and subsequent TMDLs for the basin. The Kansas Water Authority approved the Basin Plan on July 11, 2000.

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:

Agriculture: January 12, February 2 and 29, 2000
Environmental: March 9, 2000
Conservation Districts: November 22, 1999
Industry: December 15, 1999, January 13, February 9 and 22, 2000
Local Environmental Protection Groups: September 30, November 2, December 16, 1999

Milestone Evaluation: In 2006, evaluation will be made as to the degree of impairment which has occurred within the drainage and current condition of Medicine Lodge River. Subsequent decisions will be made regarding implementation approach and follow up of additional implementation.

Consideration for 303(d) Delisting: Medicine Lodge River will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2001-2005. Therefore, the decision for delisting will come about in the preparation of the 2006 303(d) list. Should modifications be made to the applicable criterion during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2002 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in Kansas Water Plan implementation decisions under the State Water Planning Process after Fiscal Year 2005.

Approved July 27, 2001.